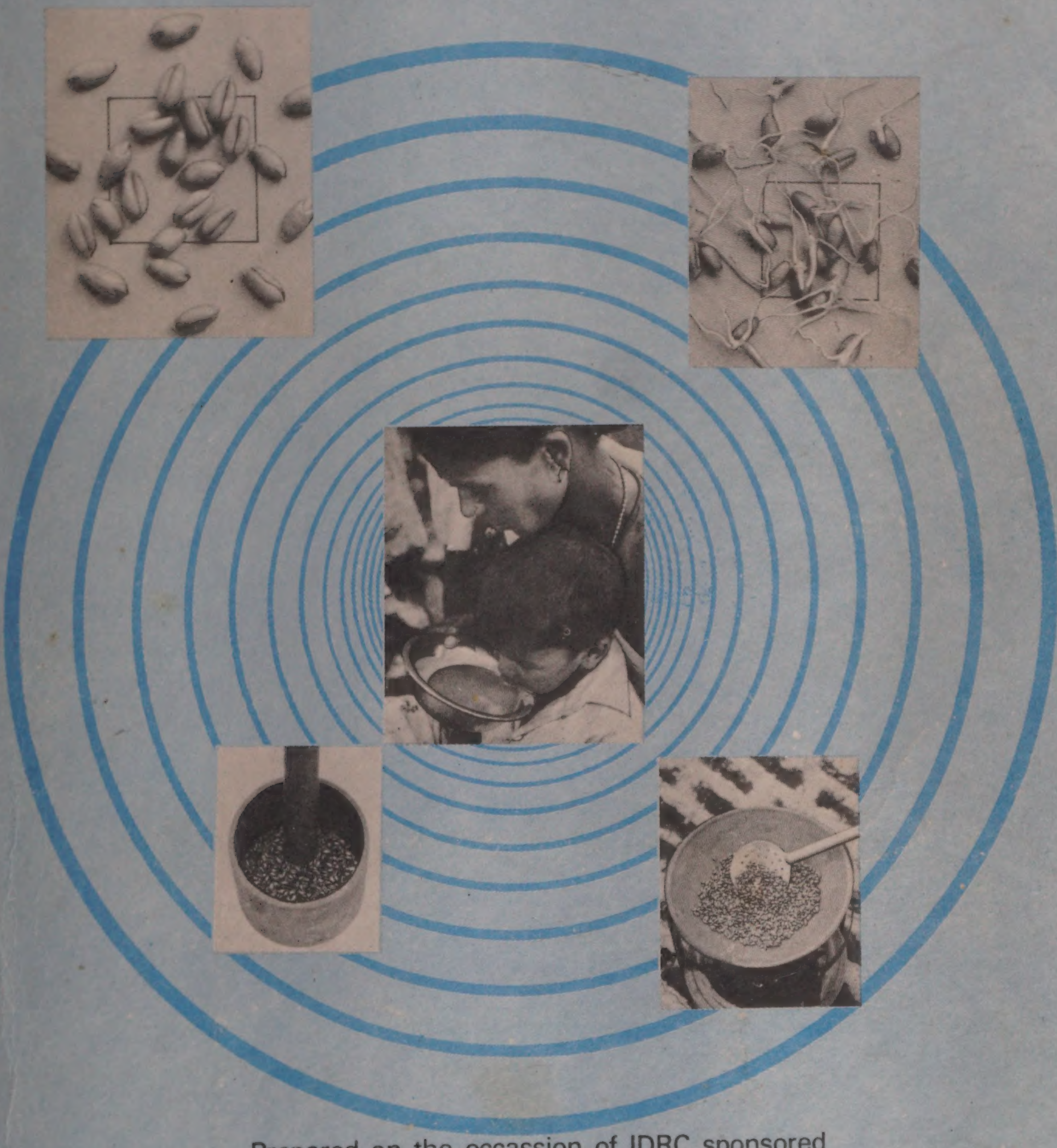
THE ARF STORY

A COMPENDIUM OF RESEARCH ON AMYLASE-RICH-FOOD

(1980-1990)



Prepared on the occassion of IDRC sponsored

NATIONAL/INTERNATIONAL WORKSHOP ON ARF TECHNOLOGY

(12th - 13th October 1990)

Department of Foods & Nutrition, Faculty of Home Science,

M. S. University of Baroda, Baroda-390 002.

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FOREWORD

We are happy to bring out the 'ARF story' which is a compilation of a decade's research work in the Department of Foods & Nutrition of the Home Science Faculty of M.S.University of Baroda, Baroda.

The compendium starts with two papers that present an overview of the role of Amylase-Rich Food (ARF) in infant feeding, with particular reference to the low income group population. For convenience, the entire research work has been grouped under Abstracts of Masters and Doctoral theses, and Summary of work in progress. A List of published papers has also been included.

A Glossary of terms and an Appendix explain various terms, items, etc. used locally which may not be familiar to all. We hope that the pictorial presentation of Simple Steps of ARF making and the use of ARF in typical gruel formulations would be of added value to those willing to try this out on their own.

The financial assistance of the International Development Research Centre (IDRC) towards bringing out this publication on the occassion of the National/ International Workshop on ARF Technology (12-13 October 1990, at M.S.University, Baroda) is gratefully acknowledged.

Tara Gopaldas

Dated : Baroda, 12 Oct. 1990

Prof Tara Gopaldas
Project Leader
Infant Foods (India) Project &
Dean, Faculty of Home Science
M.S. University of Baroda
Baroda.

CONTENTS

EFFECTIVE STRATEGIES IN YOUNG CHILD FEEDING *

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Weaning and Household Level Diets for the Young Child

The majority of children [7-24 months] in the Less Developed Countries [LDCs] are undernourished. Generally the introduction of 'Weaning Foods' to supplement breast milk coincides with growth faltering and even further nutritional decline. The weaning foods, cereal flour foods/paps, are mostly contaminated and become more so on storage in hot/humid conditions. They are high in dietary bulk and low in nutrient density. Weaning foods from the Developed world have a nutrient density of 1 Kcal/ml vs 0.25 Kcal/ml of the LDCs. The high viscosity of the gruels/paps makes it extremely difficult for the mother to feed her child quickly and the child to swallow. This is a period when the child suffers frequent bouts of illness which further lowers his appetite. An Indian child [7-12 months] receives about 500-650 ml breast milk through 8-10 feeds/day. Breast milk is one of the most nutrient-dense and complete foods and provides the baby daily with about one-third of his energy; about one-half of his protein and Ca; and all of his vitamin A and C. He hardly receives any other foods except for a few spoonfuls of gruel, some soft boiled rice and may be a biscuit. An older child [13-24 months] continues to get breast milk and is graduated to family food such as tea, tit-bits of Chapati, cooked rice-pulse combinations, bread/biscuit and an occasional banana/ mango slice. Spiced vegetable/curries are generally withheld. His daily energy intake rarely is higher than about 500 Kcal/day and this does not vary much between 7-24 months of age.

Use of Fermented and/or Germinated Flours in Young Child Feeding

Germination and fermentation are two widely used traditional technologies in Asia and Africa, which hold great promise to improve young child nutrition. The addition of a small quantity of germinated cereal flour, rich in Alpha-amylase, is able to dramatically reduce the viscosity of high dietary bulk porridges thereby making it easy for an infant/toddler to consume. Germination of a variety of pulses, especially mung [bean sprouts] is widely practised in S E Asia and of a variety of pulses and to a lesser degree wheat, in the Indian subcontinent. 'Kimea' [germinated sorghum flour] is routinely used in brewing beer in Africa and has been recently promoted in E Africa for reducing the viscosity of traditional sorghum gruels. Non-alcoholic fermentation and souring of cereal porridges by lactic acid-producing bacteria is widely practised in Africa and is traditionally used as a weaning food. Advantages of sour porridge are that it enhances bioavailability of proteins/vitamins/minerals; the low pH makes it resistent to pathogenic bacterial contamination and it is palatable.

The auto-fermentation which occurs when cereal or pulse flours are steeped in water over-night, reduces the viscosity of the subsequently cooked gruel to some extent. Fermented batters subsequently steamed [Idli,Dhokla] or fried [Dosai,Addai] are household food processing technologies in India. Another fermentation technology most popular and widely practised in India is Dahi [yoghurt] preparation. The therapeutic properties of yoghurt and buttermilk are well appreciated and these products are used for feeding of young children on a daily basis and particularly when they suffer

* Paper presented in the Symposium on "New strategies to improve child feeding practices" at the XIVth International Congress of Nutrition, Seoul, Korea [August 1989]

from diarrhoea and fever. The fermented foods such as Tempeh,Tofu of S E Asia are well-known.Such home foods are relished by weaning-age children of the region and should be promoted for being region specific, part of the culture and cuisine, and for their enhanced nutritional and health properties.

The Concept of ARF and the Relative Amylolytic Power of Different ARFs

In our decade of research [since 1979] on fully malted and partially malted multimixes and ARF, the major hurdle in popularizing the same were the enormous time, space and labour constraints. We hypothesised that small quantities of any natural food abundantly rich in Alpha-amylase such as germinated grains or fruits should be able to thin thick viscous gruels. Fruits [mashed mango/banana/papaya] were found to be poor candidates as all of the Alpha-amylase was used up in the ripening process. However, any germinated cereal grain subsequently sun-dried,lightly toasted, devegetated and milled is extremely rich in Alpha-amylase. Tiny or catalytic amounts of this Amylase-Rich-Food [ARF] or powder could instantly reduce the viscosity of extremely thick hot gruels [even upto 30g% solid concentration]. Among ARFs prepared from wheat, sorghum, maize, pearl millet, finger millet, and local millets consumed by our tribal populations, wheat ARF was found to have the most reproducible results. It required the least length of time to prepare, namely,steeping overnight [12h]; germinating for 48h; sundrying for 8h; toasting and milling - essentially a 3-days operation. Wheat ARF had an amylase activity of 4500 maltose units/g of ARF vs 1248 for maize ARF vs 1855 for sorghum ARF. As far as possible it is best to avoid germinated sorghum which elaborates dangerous levels of HCN acid. In short a mother would require only about 1g ARF to thin 100 ml of a 20g% solid concentration hot-gruel. At 2 'ARF gruel' feedings per day or 2g ARF requirement, all that she would need is 100g of wheat (allowing for devegetating losses) at a present cost of 30 paise (a fraction of one US cent). Further, time and space and cost constraints would be minimal.

The shelf life of all our ARFs as per Indian Standard Specifications for cereal flours ranged from 1 to 4 weeks. The major negative factors being moisture (more than 10%) and nonpathogenic viable plate count (more than 50000 per g ARF). If bitterness were used (suggested by Dr HSR Desikachar of India), our ARFs had a shelf-life of a year when stored in well stoppered bottles at ambient temperature (35-42°C) and fairly high relative humidity. Shelf-life,an important consideration at the slum/hut level, could be prolonged by repeated sundrying / toasting to bring moisture content to 6%.

Acceptability Trials

Acceptability trials conducted on several hundred mother-child dyads conclusively demonstrated an overwhelming positive response to the ARF-thinned-gruels among both mothers and their children. Further, controlled week-long gruel intake trials where infants/toddlers were pair-matched for age, nutritional grade, and caloric intake of home diet, demonstrated that the 20g% ARF gruel was consumed more (approximately 90 vs 30 ml in infants and 160 vs 40 ml in the 13-24 months age group).

Controlled Growth Trials

Subsequent 6-months-long controlled growth trials also confirmed that children (7 to 24 months) fed 'ARF-gruel' (20g% wheat flour including 0.8g% ARF) ad lib once a day fared much better than their counterpart group fed 'non-ARF gruel' (20g% wheat flour alone). Weekly weight records and monthly height and mid-upper arm circumference (MUAC) records were used to assess the change in nutritional status. The home diet (inclusive of breast milk) in both groups on an average only provided about 450 Kcal/day and the 'ARF-gruel' group demonstrated a significantly better growth. Increment in wt/ht/MUAC in the 'ARF-gruel' group was 2 kg, 6 cms and 1.18 cm respectively while

in the 'non-ARF' group it was 1 kg, 4.5 cms and 0.59 cm respectively. Also mean days of illness was less in former group.

In conclusion the potential of 'ARF-gruel' to improve the energy intake and growth of the young child in the LDCs is clearly indicated.

Transfer of 'ARF' Technology from Lab to Field

The last step in our sequence of research was an 'action-research' study undertaken in the Baroda slum. The study design provided for a three-tier-transfer of technology. In the first level transfer a doctoral student trained 40 Bachelor's level students in the household level production of wheat ARF. Prototype items such as volumetric plastic cups and spoons for the germination and subsequent gruel making processes; clean muslin cloth on which the steeped grains were germinated; and flat earthenware skillets to toast the germinated grains were supplied to both the second tier trainee students as well as to the third tier 188 trainee mothers. The training period for the second and third tiers were of 15 days duration each. Mothers who were mostly illiterate were each supplied with a colourful booklet depicting each step of ARF production. Every slum home had a small court-yard where germinated grains could be conveniently dried. Fortunately all homes got clean water supply (hand-pump or pipe). The recipe for the child's gruel was what was being followed anyway in most homes. It consisted of roasting the 55g wheat flour (one volumetric cup) in 20g oil (2 tbsp) or fat on a low fire. One volumetric cup of jaggery (brown crude sugar) dissolved in 2 volumetric cups (measuring 250 ml) water was slowly added. The whole gruel was constantly stirred till a very thick gruel was formed. The gruel was taken off the fire and one teaspoon of ARF (5g ARF) was added and stirred briskly till the gruel 'thinned' before the mother's eyes. This gruel of about 30g% solid concentration was highly palatable and delivered about 2.5 Kcal/ml. The trainees were deliberately made to use much more 'ARF' (4-5 times as much) for gruel liquification, to be on the safe side. In the follow-up evaluation done 3 months hence it was noted that most mothers were making the gruel regularly, but not the ARF. Approximately 90% mothers said they would buy the ARF while about 70% said they would buy or prepare it regularly on their own. Practically all those who said they would purchase the ARF claimed that they would pay from 50 to 100 paise (a fraction of one US cent) for a 100g packet of ARF if marketed. Although over 80% claimed all the steps of home-ARF production were very easy, in fact only 28% were actually preparing it on a regular basis. The major reasons for not preparing ARF on a regular basis were 'no time', 'forgot', 'had other important chores to do'. In fact, it was the better off mothers (per capita income of more than Rs.100/month) who were the regular makers of ARF. By way of contrast 83% of the mothers were making the sweet wheat gruel regularly.

Future Program Directions

India has a massive Intergrated Child Development Services (ICDS) Program covering nearly 2000 Community Development (CD) Blocks. Each CD block has roughly 100 villages, each of which has about 1000 total population and a child population in the age group of 7 to 24 months of about 45 children. It would be entirely feasible for the ICDS village center to supervise 'ARF production' through women's clubs. Even allowing for 5g ARF/child/day only about 250g of wheat would be required as the starting material for ARF. The job could even be contracted to a single enterpreneur who could make a fresh batch of ARF every day. It is also recommended that the supplementary food ration for babies/toddlers (7-24 months) be 50g wheat or staple flour, 10g oil and 50g jaggery, and 5g ARF. Such gruels could be enriched by the addition of any legume flour that is mung, chickpea, cowpea, soya etc. Another program suggestion would be to tablet ARF and undertake a social marketing approach. It could be heavily subsidized for the ICDS, but sold at viable market rates in the open market. Further, it could become mandatory policy that all proprietory brands of baby foods (high in carbohydrate) incorporate adequate levels of ARF.

CONCEPT OF AMYLASE-RICH-FOOD (ARF) AND ITS ROLE IN INFANT FEEDING AND GROWTH*

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THE PROBLEM

The vast majority of older infants (7-12 mts) in the Less Developed Countries (LDCs) are undernourished; the decline is even sharper in young toddlers (13-24 mts). The most common and first complementary food to breast milk is small amounts of viscous cereal gruel made from rice (Asia); sorghum, finger millet and maize (Africa); rice, wheat, millets, tapioca or sago (India); or sweet potato (Papua New Guinea). The cereal grains in the gruel swell on cooking and render even a 20-25% cooked paste slurry dough-like or very viscous. The challenge, therefore, was to reduce the viscosity of these traditional gruels by simple, cheap and reliable household technologies. It was hypothesized that a child would be able to imbibe more of this 'thinned' gruel per sitting and consequently increase his caloric intake.

THE CONCEPT OF AMYLASE-RICH-FOOD (ARF)

Alpha-amylase is the liquifying enzyme that breaks down long chain carbohydrates present in all cereals into shorter chain dextrins. Hence, any food abundantly rich in alpha-amylase ought to reduce the viscosity or 'dietary bulk' of a traditional gruel. Germinated cereal flours are extremely rich in Alpha-amylase and in catalytic amounts are able to thin cooked (70°C) paste cereal flour slurries (upto even 30% solid concentration) instantly. Amylase-Rich-foods can also liquify cooked slurries made from habitual diets of cereal/pulse or of Soya-Fortified-Bulgar etc. Preparation of the ARF consists of steeping the grains overnight, germinating for 48-96 hrs, sundrying for 5-8 hrs, toasting on a flat skillet, devegetating, and milling the grains. ARF preparation from as little as 100-200 g of any cereal grain for a cost of 20-40p (fraction of one US cent) would be sufficient to thin one child's gruel daily for one whole month. ARF can be prepared from germinated pulses also (mung, chickpea, cowpea, soyabean, etc.) but would have substantially less amylolytic power.

Germination is part of the traditional cuisine of Asia. In Africa, germinated sorghum or 'Kimea' flour is the standard starter for brewing of beer.

Among wheat, sorghum, maize, or other millets, wheat was found to have the shortest germination period (48h) and had the highest amylase activity (4500 maltose units/g ARF). A 20g% cooked paste gruel of any cereal powder would require hardly 1g wheat ARF for its thinning. As far as possible it is best to avoid germinated sorghum which elaborates dangerous levels of HCN acid. Moisture in the ARF can destroy the enzyme. Hence the ARF must be rendered bone dry and should be stored in a cool dry place.

ACCEPTABILITY TRIALS

Acceptability trials conducted on several hundred mother-child dyads conclusively demonstrated an overwhelming positive response to the 'ARF-thinned-gruels' among both mothers and their children. Further controlled week-long gruel intake trials where infants/toddlers were pair-matched

* Paper presented at the workshop on "Reduction in dietary bulk of traditional gruels with simple household technologies for improved child feeding" at the XIVth International Congress of Nutrition, Seoul, Korea (August 1989)

for age, nutritional grade, and caloric intake of home diet, demonstrated that the 20g% 'ARF-gruel' fed group consumed 3 to 4 times the volume of gruel per sitting as compared to the counterpart group consuming the 'non-ARF-gruel' [approx 90 vs 30 ml in infants and 160 vs 40 ml in 13-24 months age group].

CONTROLLED GROWTH TRIALS

Subsequent 6-months-long controlled growth trials also confirmed that children [7-24 mts] fed 'ARF gruel' [20g% wheat flour including 0.8g ARF] ad lib once a day fared much better than their counterpart group fed 'non-ARF-gruel' [20g% wheat flour alone]. Weekly weight records and monthly height and mid-upper arm circumference [MUAC] records were used to assess the change in nutritional status. The home diet [inclusive of breast milk] in both groups on an average only provided about 450 Kcal/day and the 'ARF-gruel' a modest net gain of 150-180 Kcal/day. Despite this, the 'ARF-gruel' group demonstrated a significantly better growth. Increment in wt/ht/MUAC in the 'ARF-gruel' group was 2 Kg, 6 cms and 1.18 cm respectively while in the 'non-ARF' group it was 1 Kg, 4 5 cms and 0.59 cm respectively. Also mean days of illness was less in former group.

In conclusion the potential of 'ARF-gruel' to improve the engry intake and growth of the young child in the LDCs is clearly indicated.

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Suneeta Deshpande and Tara Gopaldas. High calorie density, low viscosity fluids with 'FAR' (Foods-Amylase-Rich) for tube feeding of cases with gastro-intestinal-tract (GIT) problems. Article invited for publication in 'Dialogue on Diarrhoea' December, (1989).

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SIMPLE STEPS OF MAKING ARF

Preparation of Amylase-Rich-Food (ARF) begins with the germination of grains, which is not unfamiliar to the Indian household. For its use as a viscosity reducer of infant foods additional care is required to ensure sanitation and safety. ARF production starts with the selection of grains with good germination quality and ends with an appropriate storage of the powder of dried grains for an extended shelf life.

Major steps of ARF preparation are depicted pictorially as follows.

1. SELECTION OF GRAINS :

For good germination select whole, unbroken grains free from infestation.

Well Germinated Grains

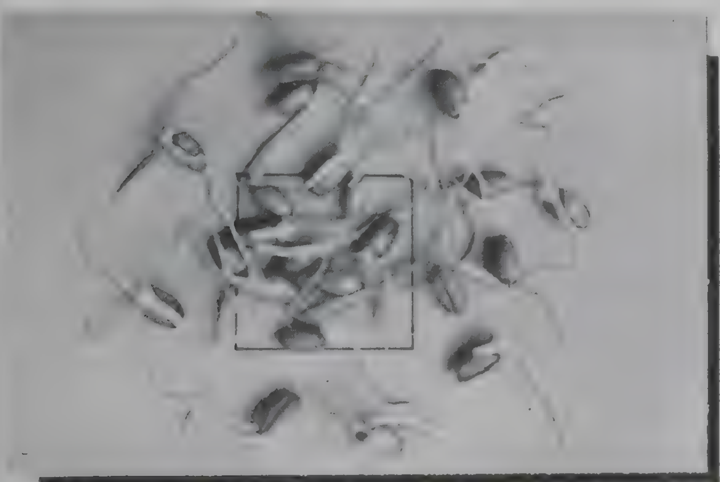


Fig.1.1 Chitting occurs within 6-8 hours of steeping. Most grains germinate. Root & shoot well developed by the end of 24 hours.

Poorly Germinated Grains

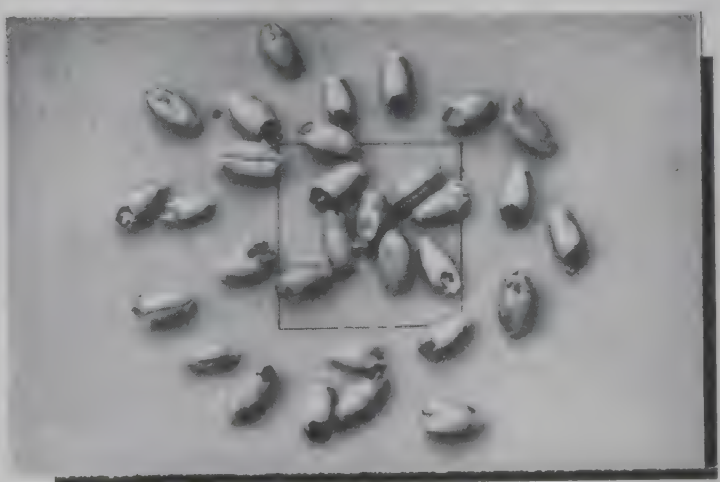


Fig.1.2 Frothing starts in the late stage of steeping. Few grains germinate. Root & shoot underdeveloped.

2. STEEPING :

Fig. 2.1 Clean debris and wash.

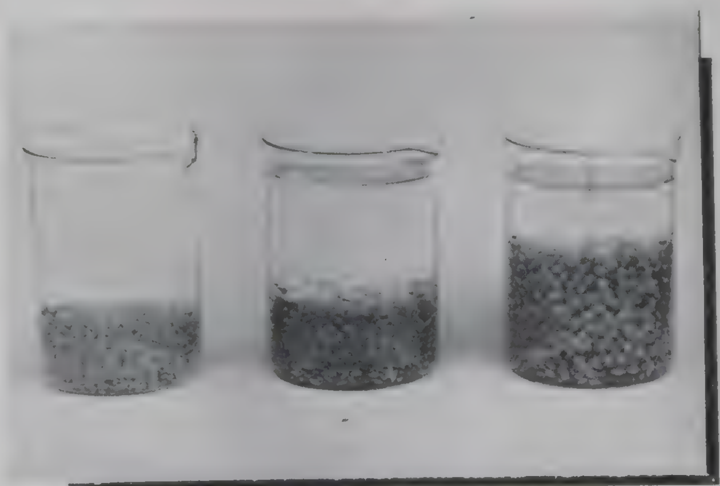


Fig.2.2 Add sufficient water (3 times the volume of grains) cover and leave for 6-12 hours.

Precautions : Water level should be sufficient to cover the swelling grains during steeping. Steeping for too long hampers germination.

3. GERMINATION :

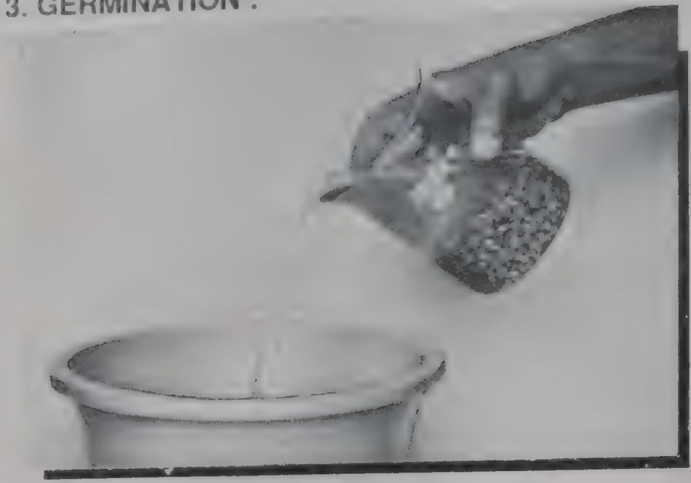


Fig. 3.1 Drain excess water.

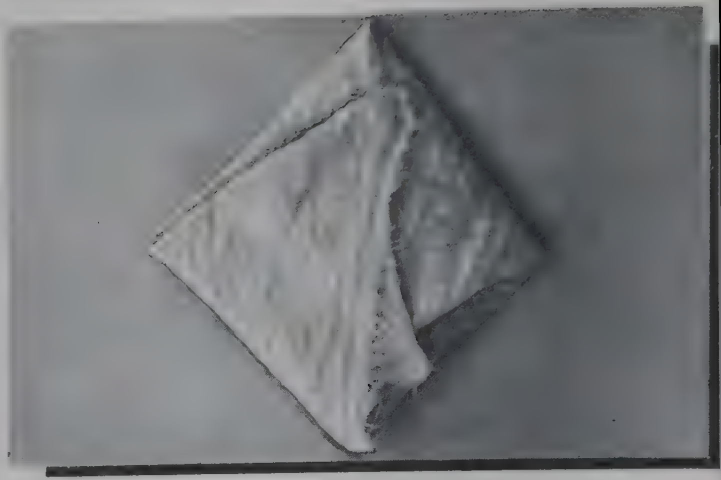


Fig. 3.2 Wrap it in a clean wet cloth.

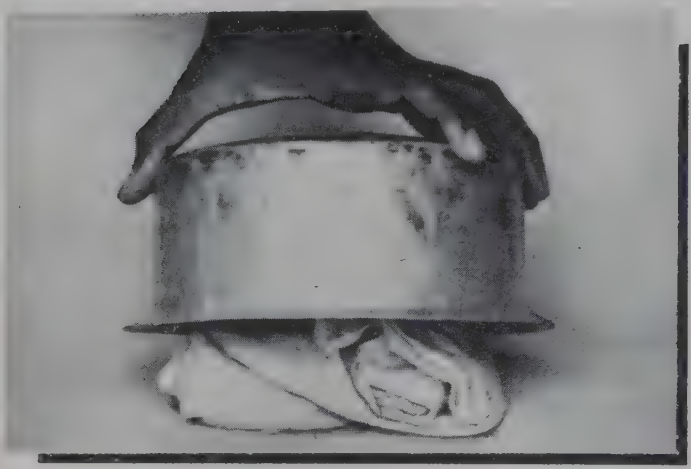


Fig. 3.3 Keep covered in a cool dark place.

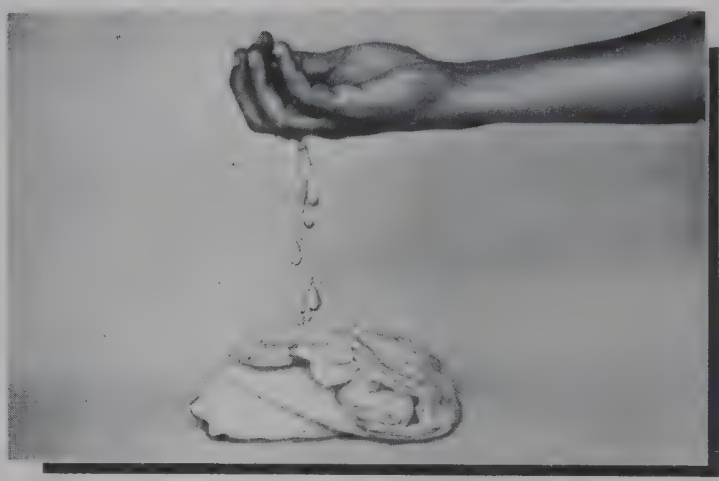


Fig. 3.4 Sprinkle water every 6-8 hours to keep the cloth moist.

Fig. 3.5 Wheat (48 hrs).

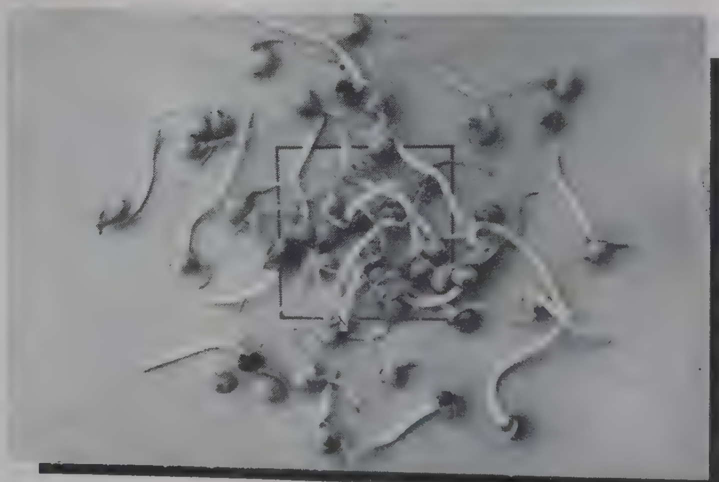


Fig. 3.6 Sorghum (72 hrs).

ig. 3.7 Pearlmillet (72 hrs).

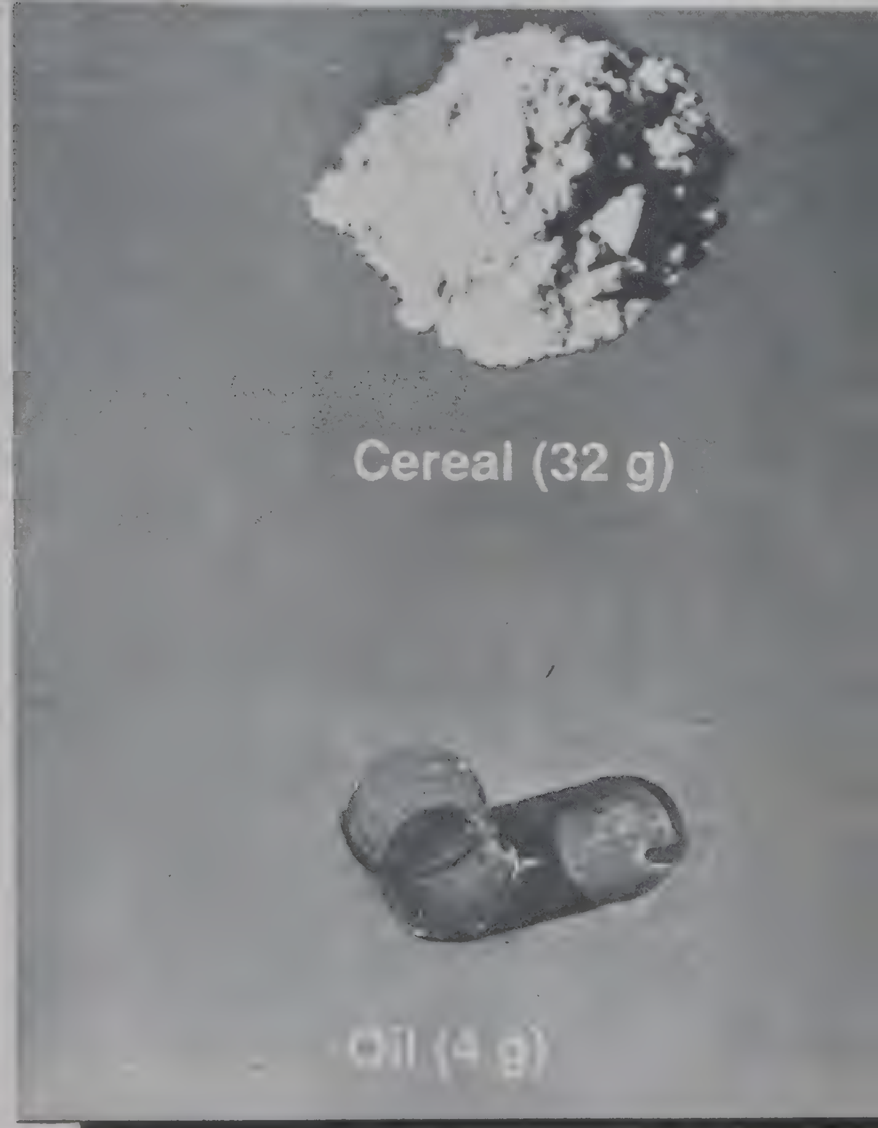
. DRYING :

g. 4.1 Preliminary drying in air/sun
th occassional stirring.

. 4.3 Final drying - light roasting o
d tava.

MAKING L

6. TYPICAL GRUEL FORMULATIONS : (Ingredients for 200 ml



7. GRUEL PREPARATION :

Fig. 7.1 Roast the dry ingredients with oil to desirable colour and aroma.

.OW VISCOSITY GRUELS USING ARF

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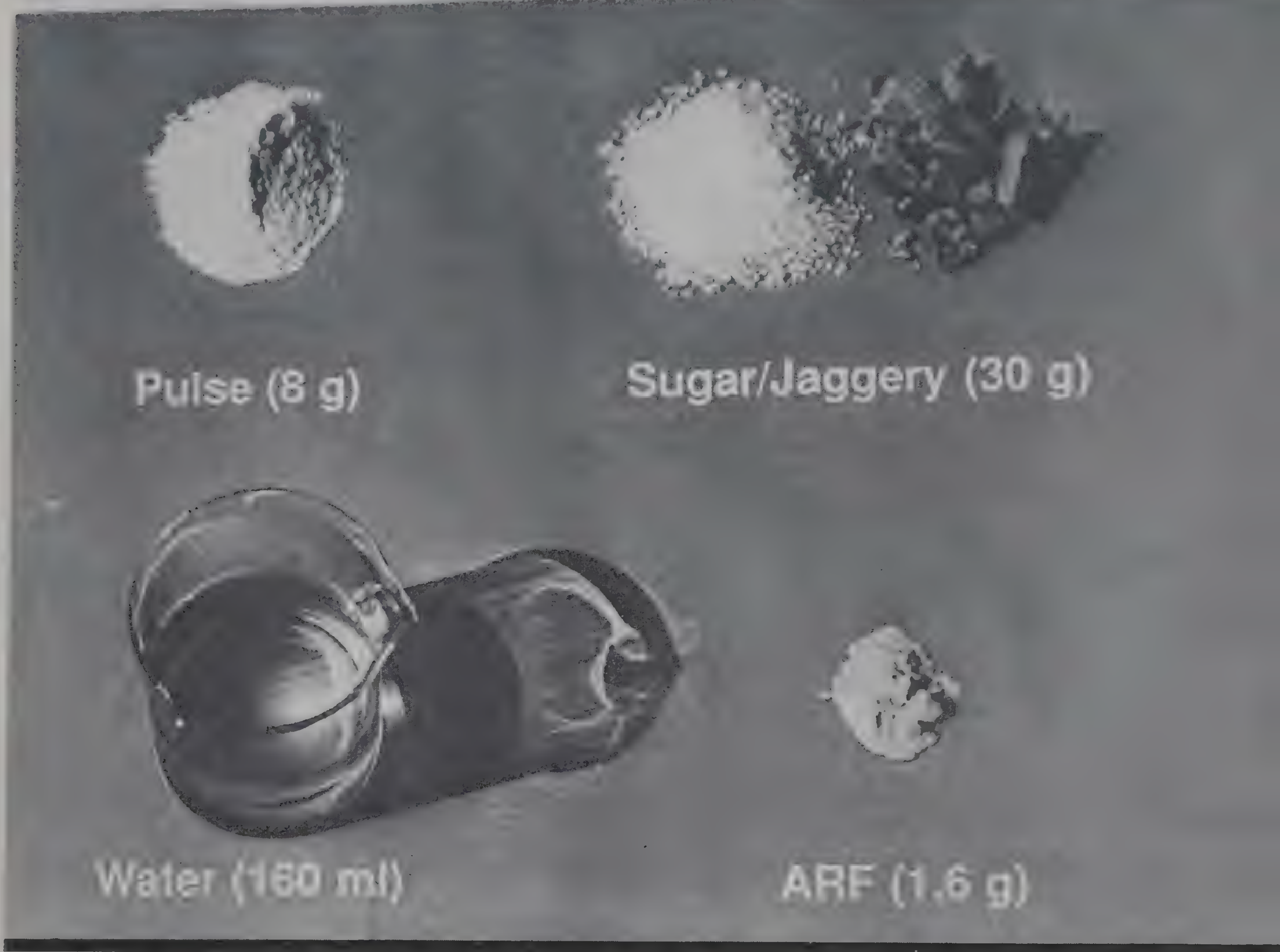

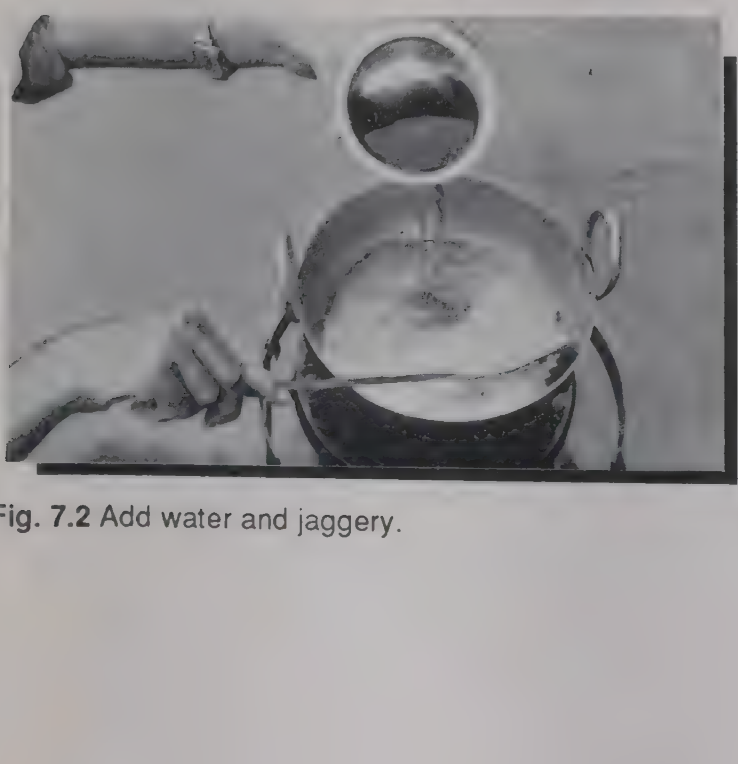

=ig. 7.2 Add water and jaggery.

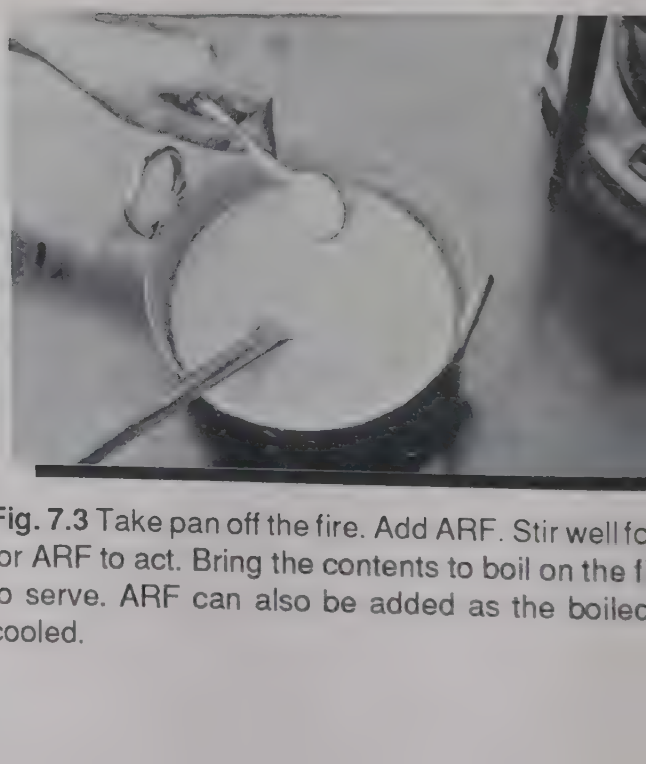

Fig. 7.3 Take pan off the fire. Add ARF. Stir well fo
for ARF to act. Bring the contents to boil on the f
to serve. ARF can also be added as the boilec
cooled.

TYPICAL GRUEL PREPARATIONS WITH ARF

Ingredients for 100 ml of gruel :

Maize gruel :

Maize flour	22.5 g
Maize ARF	2.5 g
Jaggery/sugar	15.0 g
Oil/ghee	5.0 g
Water	75.0 ml
Energy	190 Kcal/100 ml

Jowar gruel :

Jowar flour	23.0 g
Jowar ARF	2.0 g
Jaggery/sugar	15.0 g
Oil/ghee	5.0 g
Water	75.0 ml
Energy	190 Kcal/100 ml

Wheat gruel :

Wheat flour	24.0 g
Wheat ARF	1.0 g
Jaggery/sugar	25.0 g
Oil/ghee	5.0 g
Water	75.0 ml
Energy	229 Kcal/100 ml

Rice gruel :

Rice flour	21.0 g
Bajra ARF	4.0 g
Jaggery/sugar	15.0 g
Oil/ghee	5.0 g
Water	75.0 ml
Energy	190 Kcal/100 ml

Sago gruel ;

Sago/Sago flour	19.0 g
Wheat ARF	1.0 g
Jaggery/sugar	12.0 g
Oil/ghee	4.0 g
Water	80.0 ml
Energy	152 Kcal/100 ml

Cereal + Pulse gruel :

Cereal flour (4 parts) + pulse flour (1 part)	24.0 g
ARF (any)	1.0 g
Jaggery/Sugar	19.0 g
Oil/Ghee	5.0 g
Water	75.0 ml
Energy	208 Kcal/100 ml

PROCEDURE

1. The oil/ghee is heated and the cereal/millet flour is roasted till brown and removed from fire.
2. The jaggery/sugar is dissolved in water by heating slightly and added to the roasted flour and stirred well.
3. To this warm mixture the ARF is added and stirred well for 10 minutes. Then the gruel is kept on fire and cooked well.

   Alternately the ARF can be added to a readily cooked gruel when it is still hot (70 degree C) and stirred in well.

   ARF from any cereal/millet can be used for effective thinning of any starch based gruel.

GLOSSARY

ADDAI	Popular snack in India prepared by panfrying fermented cereal - pulse batters.
AMYLASE	A group of enzymes involved in polysaccharide breakdown
A.R.F.	Amylase-Rich Food
BALWADI	Child care centre
CHAPATI	Unleavened bread prepared from wheat flour by baking flattened wheat flour dough
DAL	Split, dehulled legume
DEVEGETATION	Removal of root and shoots by hand abrasion from dried germinated grains
DHOKLA	Popular snack in India prepared by steam baking fermented cereal - pulse batters with spices and seasoning.
DIETARY BULK	The high volume / viscosity characteristics of a diet in relation to its caloric content
DOSAI	Popular snack in India prepared by panfrying fermented rice - blackgram dal batter
GERMINATION	Sprouting of the grains
GHEE	Heat clarified butter fat
IDLI	Popular snack in India prepared by steam baking fermented cereal - pulse batters
I.S.I.	Indian Standard Institution currently known as Bureau of Indian Standards
KALADI	An earthen pan used for toasting
KADAHI	An iron/steel used for deep frying
KATORI	A small cup
KHICHDI	Steam cooked savoury preparation containing rice and legumes
MALTING	Process involving germination and roasting of cereals such as barley, wheat etc.
ROASTING	Application of dry heat
R.T.E.	Ready to Eat
STEEPING	Immersing the grains in adequate amount of water to promote water absorption by grains
TAKADIASTASE	Fungal enzyme (amylase) preparation

ABSTRACTS OF
M.Sc. AND Ph.D DISSERTATIONS.

A-1 STUDIES ON LOW COST MALTED READY TO EAT MIXES FOR PRESCHOOL CHILDREN (3-4 YEARS)

Farhat Inamdar (1980)

Ready-To-Eat mixes were formulated from raw, simple roasted and malted grains/oil seeds. All the powdered ingredients of three commodities were mixed together in four different proportions of cereal, pulse and oilseed as 4:1:1, 8:1:1, 4:1:0 and 8:1:0. Only malted and simple roasted mixes were sweetened with twenty five per cent jaggery. Malting was carried out for 12 hours with equal volume of steeping liquid, at room temperature. Germination in muslin cloth was arrested at 24 hours in case of wheat (Triticum aestivum) and Bengalgram (Cicer arietinum) Density of malted seeds and powders (germinated and roasted) did not vary much with the density of raw and simple roasted powders. Viscosity of malted mixes of 10 gms of mix made upto 100 ml with water and cooked was much lower than counterpart raw and simple roasted mixes. Volume of malted mixes did not vary appreciably with the rest. There was no significant difference between the organoleptic scores obtained for malted and simple roasted RTE mixes when tested on college students. Feeding trial in a Balwadi (preschool chileren 3-4 years of age) revealed that the quantities of malted RTEs consumed was significantly higher than the simple roasted mixes. Mixes with an oilseed (groundnuts) were relished more than those without the same. Bacteriological examination showed that the malted mixes were very much prone to spoilage by bacteria on storage within a short period of seven days as the plate count increased beyond the Indian standards after a week. Whereas simple roasted RTEs could remain edible even after four weeks of preparation. In conclusion, the study revealed that fully malted and fully roasted RTEs were equally well accepted by preschoolers. However, the consumption of fully malted RTEs was much higher due to their low viscosity. Fully malted RTEs had a much shorter shelf-life than fully roasted RTEs.

A-2 ACCEPTABILITY AND NUTRITIONAL STATUS TRIALS ON PRE-SCHOOL CHILDREN (1-5 YEARS) FED MALTED VS ROASTED READY-TO-EAT (RTE) MIXES AT BARODA AND PONDICHERRY

Khaja Mohammed Tajuddin (1981)

In order to combat widespread malnutrition, prevailing in India's pre-school children, several types of ready-to-eat (RTE) food supplements have been developed to meet the caloric deficit in the pre-schooler's diet. However, bulk is a major problem limiting the intake of these supplements by the pre-schoolers. The malting process reduces viscosity of a food supplement, thereby increasing calorie density through increased intake by the child at one sitting. Because there is dearth of information on malted supplements and their acceptability, the present study was undertaken with the following objectives: to develop malted and roasted RTEs; to assess relative acceptability of malted and roasted RTEs and to measure nutritional impact (if any) on the children fed RTEs. The malted RTE mix was prepared by germinating, roasting, powdering and mixing ragi (Eleusine coracana) greengram (Phaseolus aureus Roxb) and groundnut (Arachis hypogea) in the ratio of 4:1:1. Jaggery was added at 25% of total weight of mix. The roasted mix was similarly prepared except that the germination process was excluded. The cost was approximately 38-80 paise per 100 g mix at 1980 prices. Criteria for acceptability were, the child must consume at least 75% of the served RTE mix (100 g); it should not cause ill-effect; this amount should be consumed in addition to his home diet and attendance should be at least 75% of total study period. Nutritional impact parameters were: 1. Anthropometry; 2. Clinical assessment; 3. Episodes of illness and 4. Dietary intake and nutrient intake. The first study was conducted at a Foundling Home, Baroda for 28 days on 20 pre-schoolers (1-5 years), who were given malted and roasted RTE mix on alternate weeks, ad lib, over an hour at a time. Though the children consumed more than 75% of mix served, they did not relish it, cases of diarrhoea/fever were recorded during study period and because their basal dietary intake exceeded RDA, beneficial effect of addition of RTE supplement cold not be

clearly seen. Also, no difference was seen between acceptance of malted versus roasted mix. Fifty seven per cent of children had a below normal weight/height^2 ratio of 0.0015, 3 to 16% showed clinical deficiency signs and 43% children showed gastro-intestinal morbidity. There was no difference in these health parameters after intervention. Poor environmental conditions and lack of medical care rather than dietary inadequacy seemed responsible for the poor health of the subjects. Since, Baroda results were inconclusive, a second similar study was conducted at a Balwadi, in Pondicherry on 17 children (2-5 years), who were fed the same malted and roasted RTE mix on alternate weeks for two weeks. Subjects were dewormed prior to intervention. Results indicated that both malted and roasted mixes were well accepted. Mean consumption was more than 75% of mix served; consumption led to no undesirable physiological effects; the mix supplemented the basal diet and met the calorie deficit of the home diet. Attendance was recorded for more than 75% of total study days. After intervention 65% subjects had below normal weight/height^2 ratio compared to a baseline of 77%; clinical signs showed no changes; 50% children suffered from gastrointestinal morbidity before intervention compared to 6% during intervention. Before intervention the mean intake of all nutrients (except protein) was below the RDA. Deficit in calorie intake was 21 to 39% compared to RDA, which was largely met after supplementation. The malted RTE mix met the calorie deficit to a geater extent than roasted RTE mix as it was consumed in significantly higher amounts, probably because of its low-viscosity. This study, therefore, has indicated that malted RTE mixes are promising food supplements as weaning mixes and further studies along these lines are indicated.

A-3 ACCEPTABILITY TRIALS WITH MALTED RTE MIXES ON AGED WOMEN (50-80 YEARS) IN BARODA

Shinjini Pandya (1982)

The present study aimed at formulating and then evaluating the acceptability of five malted mixes among old women of 50-80 years, from low, middle and high income groups of Baroda. The keeping quality (shelf-life) of these mixes was also studied. The mixes were prepared using locally available cereal, pulse and oilseed. The five mixes formulated were (1) malted wheat (Triticum aestivum) and Bengalgram (Cicer arietinum) in 4:1 ratio, (2) malted wheat, Bengalgram and roasted groundnuts (Arachis hypogea) (3) malted wheat, malted Bengalgram and malted groundnuts, (4) malted wheat, malted Bengalgram and roasted gingelly seeds (Sesamum indicum) and (5) malted wheat, malted Bengalgram and malted gingelly seeds. The ingredients for the mix (2), (3), (4) and (5) were in the ratio of 4:1:1. The mixes were sweetened with jaggery at 25 per cent by weight of the total mix. The cost of the mixes ranged from Rs. 3.65/kg to 4.30/kg. Protein content varied from 10.38 g to 11.99 g and calorie content from 355 to 383 calculated per 100 g mix. The acceptability of the mixes was assessed at the residence of the subjects. Two hundred and seventy old women were grouped into 9 groups of 3 different ages and family income levels. The total scores for organoleptic evaluation by the 270 old women revealed no significant difference among the mixes (4), (1) and (2) which were ranked 1st, 2nd and 3rd respectively. However RTE mix (5) containing malted gingelly seeds was found to be significantly different from all the other mixes. Mix (3) was significantly acceptable compared to mix (5). The criterion set up for sensory test was that the women should score the mixes above 60 per cent of the maximum scores for acceptability. All the mixes were found to be acceptable. Considering the difference between mixes containing roasted and malted oilseeds it was inferred that mix (2) was preferred to mix (3), the difference being significant. Also mix (4) was more acceptable when compared with mix (5), the difference being significant. The keeping quality of these malted mixes was studied at Sarabhai Research Centre for 42 days. The mixes were drawn at intervals of every 7 days of the storage period. The criterion for evaluation of the storage quality of all the mixes was that the parameters to be evaluated were to meet the Indian Standards (IS) specifications. The 6 parameters used were 1) Moisture, 2) Free Sugar, 3) Alcoholic Acidity, 4) Peroxide Value, 5) Total Protein and 6) Bacteriological Examination. The study indicated that all the malted RTE mixes could meet the I S specification for processed foods throughout the experimental period of 42 days. This study, therefore, indicates the possibility

of bulk production of malted RTE mixes at the commercial level for the aged, as the malted mixes were positively accepted by this section of the population.

A-4 STUDIES ON ROASTED, MALTED AND COMBINATIONS OF ROASTED + MALTED RTE MIXES WITH RESPECT TO VISCOSITY, RECIPE FORMULATION, ACCEPTABILITY AND SHELF QUALITY

Vanamala R Nayak (1983)

The present study was undertaken with the main aim of obtaining the most suitable roasted + malted (R+M) proportion in Ready-To-Eat (RTE) mixes, with substantially reduced viscosity as compared to the roasted (R) one. The other related objectives were to formulate low-cost snack recipes for young children (3 to 5 years), to find out their acceptability in the same age group, and to study the shelf quality of RTE mixes over a period of 28 days. Wheat (Triticum aestivum), Bajra (Pennisetum typhoideum), Bengalgram (Cicer arietinum) and Greengram (Phaseolus aureus Roxb), the most commonly used grains in Gujarat were used to formulate RTE mixes having cereal : pulse combinations of 4 : 1. For selecting most suitable R + M proportion, viscosity of the 10% slurries made from various R + M proportions of mixes was determined in a Brookfield viscometer. Results revealed that malting of the pulses did not lead to a marked reduction in viscosity whereas malting of cereals caused a fall in viscosity by about 50% as compared to their R counterparts. The proportion of 40% + 60% (R+M) cereal in the mixes was judged to be the most suitable proportion with markedly reduced viscosity as compared to their R counterparts. Two snacks were developed from each of the R, M and R + M wheat mixes. These were porridge and biscuit. Acceptability trials for these snacks were carried out on 30 Balwadi children (3 to 5 years) in Baroda. Each type of snack was served for two days with an interval of a day in-between. Total intake was calculated from the difference between the total amount given and total left-over. Acceptability trials reflected that malting of wheat led to a higher intake only in the case of porridge. The feasibility of using R + M wheat mix instead of M alone in the preparation of porridge was also established as both these types of porridge were equally acceptable. The samples were drawn on the 0, 7th, 14th, 21st and 28th day for analysing moisture content, alcoholic acidity and peroxide value. Based on all these parameters, it was observed that all the mixes except those having Bajra could meet the Indian Standard specifications till the last day of storage. Also as the R + M cereal mixes had lower values for all the three parameters, when compared with completely M cereal mixes, the R + M cereal mix could be kept in an edible condition for a longer period of time.

A-5 STUDIES ON RICE BASED MALTED MIXES

Hemangini I Gandhi (1985)

The major objectives of the present study were : (i) To prepare malt from Bajra (Pennisetum typhoideum) and evaluate its acceptability. (ii) To evaluate the keeping quality of the Bajra malt. (iii) To compare its thinning quality and ability to reduce the viscosity of rice based gruels with that of a pure enzyme i.e. Takadiastase. (iv) To evaluate the acceptability of gruels prepared from various types of rice flours with and without Bajra malt. An acceptable Bajra malt was developed by steeping Bajra grains for 2 hours in water; germinating for 72 hours; air drying till brittle to touch and finally roasting for 15 minutes at 100 to 110 degree C. A trained panel using the Threshold Test and Hedonic Rating test assessed the malt to be acceptable.The shelf-life of the malt was 21 days at 4 degree C as per Indian Standards (IS) specifications. Malt samples were drawn on 0, 7th, 14th, 21st and 28th day. The parameters used were moisture, alcoholic acidity, peroxide value, free sugar and bacterial plate count. The thinning effect of the malt or pure enzyme were evaluated in three ways 1) Visually. 2) By using a Viscometer, 3) By estimating the amylase activity of the malt and the pure enzyme. For measuring the thinning effect, a 10% hot paste slurry was prepared from raw and roasted flours of jirasar and ration shop rice, puffed and flaked rice with

and without the addition of 1 to 4 g% of malt or pure enzyme. Visually, gruels without malt or enzyme were very viscous; while those with malt were thin. The thinning power of enzyme was estimated to be 4 times more powerful as that of malt. Viscometer (Brookfield) readings revealed the same trend. The difference in viscosity of a hot-paste slurry prepared from jirasar and ration shop rice flours was negligible. The amylase activity of the enzyme, however, was 6.6 times higher than that of the crude malt. Three day acceptability trials of 10% hot-paste gruels of rice flours with and without malt at 4g% were conducted on 30 toddlers (1-3 years of age) and their mothers. Results showed that children greatly preferred the gruels with malt; as did their mothers. A similar trend in favour of gruels prepared from puffed or flaked rice with malt versus those without the malt emerged. Similar 3 day acceptability trials on infants (less than 1 year of age) and their mothers also established that infants were able to consume abut 100 ml of a rice gruel with malt (malted gruel) at a sitting versus 50 ml for a rice gruel without the malt (non-malted gruel). Mothers of these children also preferred the gruel with the malt. To conclude, (i) The development of a crude Bajra malt is a simple, feasible, cost effective and appropriate technology for the village level. (ii) The mere addition of 4g of malt to 100g of rice flour can bring about substantial reduction in the bulk density of hot-paste gruels. (iii) Keeping quality of the malt is about 3 weeks at room temperature. (iv) Children (toddlers and infants) consumed substantially greater amounts of gruels with malt versus gruels without the malt.

A-6 EFFECTS OF PROCESSING ON THE NUTRITIVE COMPOSITION AND PROTEIN QUALITY OF CEREAL PLUSE MIXES WITH OR WITHOUT GREEN LEAFY VEGETABLES

Anuradha Goyle (1986)

Malting has been reported to enhance the nutritive vlaue of the grains, hence the present study was planned to use malted grains in the preparation of a snack, together with a dried green leafy vegetable and to investigate the effect of heat treatment on the nutritional quality of the malted grains in the preparation of a snack. Optimal conditions for malting of grains were determined and changes in carbohydrate profile and protein content studied. Biscuits were prepared from malted or raw wheat (Triticum aestivum) and bengalgram (Cicer arietinum) mixes with or without colocasia (Colocasia anti-quorum) leaf powder and tested for acceptability on 3 to 6 year old children and their mothers. Nutritive composition, keeping quality and protein quality of the mixes and bisucits were determined. In order to determine the optimal soaking time for maximal germinative capacity of wheat and bengalgram, grains were soaked for 4 to 24 h and germinated for 24 or 48 h. It was observed that 12 h of soaking and 48 h of germination for both the grains were optimal as the grains exhibited cent percent germination all having measurable (more than 0.2 cm) sprout lenghts. In addition, changes in carbohydrate profile and protein content were monitored over a germination period of 72 h in 12 h soaked wheat and bengalgram grains. The starch contents of wheat and bengalgram grains consistently decreased while the total and reducing sugar contents increased until 48 h of germination, thereafter the values tended to decrease. The protein content of wheat and bengalgram had shown increases of 8 and 5% respectively, over the germination period of 72 h probably due to losses in dry matter. The changes in total and reducing sugars of wheat and bengalgram grains confirmed that the grains be germinated for 48 h. Biscuits containing 2 or 3%, 3 or 5% and 5 or 10% colocasia leaf powder were prepared and subjected to sensory evaluation. The results of the triangle test showed that the biscuits containing 2, 3 or 5% colocasia leaf powder were not differentiated; while those of the composite scoring test and hedonic scale revealed that biscuits containing 10% colocasia leaf powder were less accepted than those containing 5% colocasia leaf powder. Hence the colocasia leaf powder was incorporated at 7.5% level so that at this level the biscuits met the RDA of a 4 to 6 year old child for iron and beta carotene and half that of calcium (Gopalan etal 1985). Raw mix biscuits and malted mix biscuits with or without colocasia leaf powder were tested for acceptability on Balwadi children. Analysis of variance showed that all the types of biscuits were equally acceptable with respect to their mean intakes at one

sitting. The mothers of these children had also liked the biscuits containing colocasia leaf powder. The nutrient analysis of mixes and biscuits revealed that malting had not markedly improved the nutritive composition of the mix except for iron and riboflavin contents. consequently the nutritive composition of malted mix and raw mix biscuits and colocasia-malted mix and colocasia-raw mix biscuits was comparable. But the addition of dried colocasia leaf powder had markedly increased the contents of protein, calcium, phosphorus, iron - total, soluble and ionizable, carotene, thiamine and riboflavin. For determination of keeping quality of mixes and biscuits, these were stored under accelerated and room conditions. It was observed that the malted and raw mixes could be kept for 28 days and may be longer at both accelerated and room conditions based on moisture gain, alcoholic acidity and peroxide value. Biscuits had a keeping quality of nearly 14 days at accelerated conditions and of 28 days and may be more under room conditions with respect to moisture gain and loss of crispness. Animal experiments conducted to determine the growth promoting ability and protein quality of mixes and bisuits showed that malting of grains significantly improved the NPU (Net Protein Utilisation) and BV (Biological Value) values of the malted mix in comparison to those of the raw mix although the PER (Protein Efficiency Ratio) values were comparable. The rats fed biscuit diets exhibited growth arrest which was larger in case of malted mix biscuit diet fed group. Addition of colocasia leaf powder increased the loss of weight in rats. The findings suggest that malted grains should not be subjected to heat treatment as in preparation of biscuits and that biscuits containing colocasia leaf powder although were well accepted, nutritionally superior and could stay in good condition for a month under room conditions but failed to improve the growth of rats in comparison to those fed biscuits without colocasia leaf powder.

A-7 STUDIES ON AMYLASE RICH FOOD FROM MAIZE (ZEA MAYS) WITH RESPECT TO AMYLASE ACTIVITY, VISCOSITY REDUCTION PROPERTY, KEEPING QUALITY AND SUITABILITY FOR ITS USE IN MAIZE BASED WEANING GRUELS

Sonia Kapoor (1986)

The present investigation was designed with the major objectives of preparation of amylase rich food (ARF) from maize with optimum amylase activity by utilizing simple village technology and to assess the possibility of using it as a thinning agent for conventional maize based, starchy weaning foods of tribal population. The study aimed at preparing such a malt (ARF) which will reduce the dietary bulk considerably and increase the caloric intake of tribal infants and young children. For this purpose an attempt was made in the following directions : 1) to evaluate the effect of processing conditions (sun and ovendrying, without removal of vegetative portion) on enzyme activity of ARF, 2) to study the viscosity changes due to addition of ARF to maize flour slurries, 3) to evaluate the keeping quality of ARF and 4) to study the intake of gruels prepared with and without ARF. An amylase rich food prepared by steeping the grains for 12 hrs in double volume of water, germinating for 96 hrs, drying in oven at 50 degree C followed by removal of vegetative portion and grinding resulted in ARF having optimum amylase activity. Results of different processing conditions on enzyme activity of ARF revealed that the removal of vegetative portion of malted grains did not affect the enzyme activity of ARF prepared from them and sun-dried ARF had higher amylase activity than oven-dried ARF. The studies on viscosity changes revealed that 15% solid concentration slurry was most suitable for young child feeding because of its consistency and nutrient density. Relative thinning effect of ARF/Takadiastase, when added to 15% hotpaste slurry at different levels (1 to 8 g%), indicated that the crude ARF was a better liquifier of cereal preparations than pure Takadiastase. Addition of different levels of ARF to a 25% hot paste slurry showed that addition of 6g% of ARF could convert the dough-like consistency to a thin consistency which can be consumed by young childern. Use of oil and jaggery in a 15% slurry further reduced its viscosity. Results on storage quality parameters revealed that gradual increase in moisture content and alcoholic acidity and decrease in free sugar took place during a storage period of 28 days. Though no change was found in peroxide value and organoleptic acceptability, a sudden reduction in amylase

activity took place on 28th day of storage. Feeding trials of 15% hot paste gruels of maize flours without and with ARF at 5g% levels on infants and toddlers highlighted that children consumed the porridge with ARF in much larger quantities as its intake was two times higher as compared to the porridge without ARF. The findings of the present study suggest that a simple low cost malt (ARF) with good keeping quality can be prepared from maize by using simple household technology. Such a malt when added in catalytic amounts can result in a substantial reduction in viscosity of maize-based weaning foods. This could help tribal infants and children to imbibe much more of their habitual gruels and therefore, increase their calorie consumption.

A-8 STUDIES ON AMYLASE RICH FOOD FROM JOWAR (SORGHUM VULGARE) WITH RESPECT TO AMYLASE ACTIVITY, VISCOSITY REDUCING PROPERTY, KEEPING QUALITY AND SUITABILITY FOR ITS USE IN JOWAR BASED WEANING GRUELS

ASHU CHAUDHARY (1986)

The present study was an attempt to develop an Amylase Rich Food (ARF) from jowar (Sorghum vulgare) with optimum amylase activity and explore its bulk reducing effect on a 10% hot paste slurry prepared from jowar flour. The investigation also included the estimation of amylase activity with respect to different periods of germination, processing conditions and varietal differences. The acceptabilities of porridges with and without the ARF in terms of comparative gruel intake and effect of storage on ARF were evaluated. Jowar ARF was prepared by steeping and germinating the grain for 12 and 72 hrs respectively followed by drying in an oven at 50 degree C till dry to touch and removing the vegetative portion before milling the malted grains. Amylase activity in all the samples increased with progressive germination. Removal of vegetative portion caused significant difference on the amylase activity. Sun-dried ARF samples possessed significently higher amylase activity than oven-dried samples. An increase in solid concentration resulted in increased viscosity of slurry. Ten percent slurry concentration was found to be the most appropriate for child feeding. For measuring the thinning effect of ARF,10% hot paste slurries were prepared from jowar flour with or without the addition of 1 to 7g% of ARF or pure enzyme Takadiastase. The liquifying power of ARF was found to be 7-8 times higher than that of Takadiastase. Inclusion of ARF at 3g% level in the slurry dramatically liquified the initially thick and viscous gruel to thin and of free flowing consistency. The elaboration of amylase activity was found to be responsible for the fall in viscosity of gruels. Maximum reduction in the viscosity was noticed by addition of ARF prepared by germinating the grain for 96 hrs. Jaggery and oil could bring down the viscosity only to a small extent. Addition of 6g% ARF was sufficient to convert the dough-like consistency of 25% solid concentration gruel to spoonable consistency like that of 10% gruel without ARF. Acceptability trials of 10% hot paste gruels of jowar flour with and without ARF were conducted on 30 toddlers (1-3 yrs) and 20 infants (6-12 months).Results showed that the children greatly preferred the gruels with ARF. They consumed the porridge with ARF in significantly higher amounts than that without ARF. Thus, the addition of ARF was effective in lowering the viscosity of gruels making it possible for the child to consume relatively more amounts of ARF added gruel than the one without it. To see the effect of storage on ARF, samples were drawn on 0, 7th, 14th, 21st, 28th days and were analysed chemically and organoleptically. The parameters used were moisture, alcoholic acidity, peroxide value, free sugar, amylase activity and organoleptic testing. Both sun and oven-dried ARF samples could be stored at room temperature for 28 days as per Indian Standards (IS) specifications. In conclusion, ARF on account of its ease of preparation, good keeping quality and relatively low cost in comparison to pure amylase can be used effectively for thinning of traditional gruels.

A-9

STUDIES ON WEANING GRUELS FROM MAIZE (ZEA MAYS) : EFFECT OF PROCESSING TECHNOLOGY ON VISCOSITY REDUCTION PROPERTIES, KEEPING QUALITY, NUTRITIVE VALUE AND SUITABILITY OF WEANING GRUELS FOR MAIZE EATING POPULATION

Manmeet Chhabda [1987]

Poor rural/tribal children in India are usually weaned on cereal products cooked for adults which are are made into bulky gruels, thus limiting the intake of young children. Therefore the main objective of the study was to explore simple, traditional, household methods of preparing weaning foods with low bulk and high energy density, using locally available raw material at low cost. To achieve this aim the study was planned with an attempt . 1] To prepare maize slurries using a variety of treatments such as roasting, parboiling, popping, flaking, fermentation and malting, 2] To study the changes in viscosity of the slurries brought about by subjecting the maize to various processing techniques, 3] To study the keeping quality of the processed maize products at room temperature, 4] To study the changes in nutritive value because of processing, 5] To measure the intake of maize gruels by young children. Slurries were prepared from maize flours at different solid concentrations [15%, 20% and 25%] and were heated in a water bath at 80 - 85 degree C. Once the slurry temperature rose to 60 degree C further cooking was carried out for 15 minutes Auto-Fermented slurries were prepared using plain maize flour and cold water and kept for fermentation for 8, 12 and 16 hours, at 28 degree C to 32 degree C in an incubator., The slurries were cooked in the same way as for other slurries.It was observed that as the period of fermentation and slurry concentration increased increased,the volume of the fermented slurry also increased and there was a progressive drop in the pH. The studies on viscosity changes revealed that when plain maize flour was used, a 20% solid concentration gave a slurry of spoonable consistency. The same was true for roasted maize slurry. Parbolied maize slurry gave spoonable consistency at 25% solid concentration. Popped and flaked maize slurry gave spoonable consistency at 20% solid concentration.Slurries made from malted maize and slurries with ARF had thin consistency at all concentrations. Fermented slurry was of spoonable consistency at 25% solid concentration. Result of storage quality parameters revealed that gradual increase in moisture content and alcoholic acidity took place during the storage period of 30 days. No change was found in the peroxide value. All flours showed gradual deterioration in organoleptic acceptability. Results on change in nutritive value of maize with respect to thiamine, riboflavin and ascorbic acid content revealed that maximum increase in the thiamine and riboflavin content was seen in malted and fermented maize slurries. Moreover, only malted sample showed presence of ascorbic acid. Feeding trials of 20% hot paste gruels of different maize flours showed that children greatly consumed the gruels with amylase rich food [ARF] and those made from fermented and parboiled maize. Intake of these gruels was significantly higher as compared to the plain maize flour gruel. The intake pf gruel with ARF was slightly more than double and that made from fermented slurry was almost double when compared with the control [plain maize flour] gruel. The findings of the present study confirmed the previous work of Kapoor [1986] that, addition of ARF in catalytic amounts can result in classical reduction in viscocity of maize based weaning foods. This study further suggests that fermentation is the second best alternative to malting as it also brings about considerable reduction in viscosity of maize based weaning gruels. Therefore, wherever malting process is difficult to carry out, fermentation serves as a cheap, easy and practical method to reduce dietary bulk of weaning foods in the diet of poor rural/tribal population.

A-10

STUDIES ON SAGO BASED GRUELS WITH WHEAT [TRITICUM AESTIVUM] AMYLASE RICH FOOD

Gita Kurani [1987]

The present study was an experiment to develop an Amylase Rich Food [ARF] from wheat having optimal amylase activity and to assess its catalytic effect on the reduction in viscosity of sago based weaning gruels. The investigation also included the estimation of Amylase Activity of ARF with respect to the period of germination and the varietal differences among the grains. Wheat ARF was prepared by steeping and germinating the seeds for a period of 12 hours and 48 hours respectively followed by oven drying the grains at 50 degree C; removal of the vegetative part of the grain; and grinding flour which consisted of the ARF. Amylase activity of grains increased progressively with the period of germination. Amylase activity of grains was maximum when the grains were germinated for a period of 48 hours. Local market varieties were seen to yield good ARF. Sago slurry with 10% solid concentration was found to be best suited for child feeding. In order to measure the catalytic action of ARF, 10% hot paste slurries were prepared from sago flour with and without the addition of ARF or pure enzyme Takadiastase added at the levels of 1 to 6%. ARF was shown to have a 2 times higher liquifying power than that of Takadiastase and incorporating it at 4% levels magically altered the initial lumpy and viscous slurry to a thin smooth and of free flowing consistency. Oil and jaggery affected the palatability and energy density of the gruel but not the viscosity. Acceptibility trials on 17 children [6-24 months] fed gruels with and without ARF, indicated greater preference for gruels with ARF. Lowering the viscosity of gruels made it possible for the child to consume relatively higher amounts of ARF based gruel than that without ARF. This was evidenced by the significantly higher consumption of gruel with ARF over the gruel without ARF. Thus, it can be concluded that on account of its ease in preparation and catalytic effect on reduction in viscosity of sago gruel, ARF compared much better with pure enzyme amylase and hence can be easily used to achieve better young child feeding within the economic constraints of poor communities.

A-11

A STUDY ON THE MALTING PROPERTIES OF KODO MILLET [PASPALUM SCORBICULATUM]: EFFECT OF VARIOUS AMYLASE RICH FOODS ON THE BULK REDUCING PROPERTY OF KODO BASED GRUELS

Priti Patel [1988]

In the present study an attempt was made to develop an Amylase Rich Food [ARF] from kodo millet [Paspalum scorbiculatum] with optimum amylase activity and to observe its effect on dietary bulk of a 20% kodo based slurry. An attempt was also made to develop ARFs from wheat [Triticum aestivum], maize [Zea mays] and jowar [Sorghum vulgare] and study its effect on kodo based gruels. The effect of storage on dry kodo based mixes was studied for a period of 30 days. Intake of kodo based gruels by infants and toddlers belonging to kodo eating population and acceptability of the same by their mothers was evaluated. Kodo millet ARF could not be prepared even after 96 hours of steeping and 120 hours of germination. There were problems faced like leaching of material from the grains, slime formation, (water had to be changed everyday) and fungal contamination. The grains did not show sufficient amylase activity, therefore, ARFs from wheat,maize and jowar were prepared and their amylase activity was evaluated. Wheat had the highest amylase activity followed by jowar and maize. An increase in solid concentration resulted in increased viscosity of the slurry. Greengram[Phaseolus aureus Roxb] dhal flour [30 parts] was added to plain kodo flour (10 parts) to prepare slurries and their viscosity was measured. Addition of pulse improved the protein value of tyrosine deficient kodo based grules but it also increased the viscosity. Twenty percent of slurry concentration of both with and without greengram dhal slurries, was found to be the most appropriate for child feeding. For measuring the thinning effect of wheat, maize and jowar

ARF, 15 and 20% kodo slurries with and without greengram dhal were prepared and the effect of addition of ARFs at 4-8% was observed. Inclusion of wheat ARF at 8g% level dramatically liquified the initially thick gruel to a child eating consistency. Microbial tests to detect presence of pathogens in uncooked and cooked slurries revealed that cooked slurries were safe for using as weaning gruels. To observe the effect of storage on on dry kodo based mixes, samples were drawn on 0, 10th, 20th and 30th day and were analysed chemically and organoleptically. The parameters used were moisture content, peroxide value, bacteriological count and organoleptic testing. All samples showed no contamination and could be safely stored at room temperatures for 30 days as per IS specifications. Intake trials of 20% gruels, of kodo flour with and without greengram and with and without inclusion of 8g% wheat ARF, were conducted on 15 infants (6-12 months) and 15 toddlers (1-3 years). The mothers of these children were asked to evaluate the gruels in terms of taste and smell. Results revealed that the intake increased significantly on addition of ARF. Addition of pulse showed lower intake but was significantly higher than plain kodo flour gruels. Thus, the addition of wheat ARF was found to be most effective in lowering the dietary bulk of kodo based gruels. The present study suggests feasibility of using wheat ARF for reducing dietery bulk of kodo based weaning gruels for population using kodo millet as their staple food.

A-12 STUDIES ON WEANING GRUELS FROM MAIZE (ZEA MAYS) AND GREENGRAM DHAL (PHASEOLUS AUREUS ROXB) EFFECT OF FERMENTATION AND MALTING ON PHYSICO-CHEMICAL CHANGES, BULK REDUCTION PROPERTY AND SUITABILITY FOR CHILDREN BELONGiNG TO MAIZE EATING POPULATION

Punita Patel (1988)

In rural/tribal households, usually a cereal staple diet is used for weaning which, due to its high starch content results in a high bulk, low nutrient dense weaning food. Fermentation technique reduces dietary bulk and enriches foods with vital nutrients. It is a simple technique involving very little time, labour and cost and can hence be easily adopted in poor homes. In this study, the feasibility of the use of fermented maize-based gruels for weaning was explored. Greengram (Phaseolus aureus Roxb) dhal was also added to maize (Zea mays) to enhance its protein value and also to observe the effect of this pulse on bulk reduction properties of maize slurries. The physico-chemical changes and viscosity reduction on fermentation of plain maize flour as well as maize (30 parts) + greengram dhal flour 10 parts) under various conditions (variations in time, temperature and slurry concentration) were studied. Microbiological studies in terms of detection of pathogens in fermented cooked and uncooked slurries were carried out , to assess whether they were safe for consumption by children. Shelf-life of maize-base dry mixes was studied , in terms of changes in peroxide value, organoleptic acceptability, total plate count and detection of pathogens. Intake studies of selected fermented maize-based gruels were conducted on children, to determine acceptability and intake of these gruels. It was observed that in all the maize-based slurries, there was a decrease in pH with increase in titratable acidity as fermentation progressed, at all temperatures. Viscosity studies on cooked, fermented maize as well as maize + greengram dhal flour slurries revealed that all fermented slurries had a considerably lower viscosity as compared to unfermented slurry. The best viscosity reduction was seen in 15% slurries fermented for 8 hours at 35 degree C and 20% slurries fermented for 8 hours at 40 degree C temperature. In case of maize + greengram dhal flour slurries, best reduction in viscosity was observed in 15% slurries fermented for 8 hours at 45 degree C and in 20% slurries it was observed after 12 hours at 40 degree C temperature. The viscosity of maize slurries was higher when the pulse (greengram dhal) was added. Addition of maize ARF to fermented maize flour and maize + greengram dhal flour slurries, led to a further reduction in viscosity. Microbiological studies revealed that all the bacterial contamination seen in fermented, uncooked slurries was destroyed on cooking, hence rendering them safe for consumption by children. Shelf-life studies showed that all maize-based dry mixes could be safely stored upto one month without any chemical, organoleptic or microbiological deterioration. Intake studies of

selected maize-based gruels on children showed that all fermented gruels had a significantly higher intake as compared to unfermented maize gruel (Control), the highest intake being in fermented maize flour gruels with maize ARF added to it. Thus, this study revealed that fermentation was very effective in reducing of dietary bulk of maize-based gruels. The addition of pulse led to an increase in bulk and reduction in intake to some extent. A combination of the techniques of fermentation and malting resulted in maximum viscosity reduction and can thus be recommended for institutional feedings.

A-13 A STUDY ON THE DEVELOPMENT OF AN AMYLASE RICH FOOD FROM BUNTI (ECHINOCHLOA STAGNINA) AND ITS USE IN PREPARATION OF LOW BULK WEANING GRUELS

Anbarasi Edward Raj (1989)

The present study aimed at developing an amylase rich food (ARF) from Bunti (Echinochloa stagnina) and explore its bulk reducing property on traditional weaning gruels prepared from Bunti flour. This included other related objectives - 1) To assess the amylase activity for different periods of germination and different processing conditions, 2) To study the effect of solid concentration on the hot paste viscosity and the changes observed in viscosity on the addition of ARF at graded levels (1-7%), 3) To study the effect of storage on certain parameters. Bunti ARF was prepared by steeping the cleaned grains for 24 hrs and germinating for 36 hrs followed by oven-drying at 50 degree C. The vegetative parts were removed by hand abrasion, and milled to a fine powder. Sun-dried ARF samples had a higher amylase activity than oven-dried samples and amylase activity increased with germination period. Studies on viscosity measurements revealed that at 10% slurry concentration, the nature of the slurry was a free flowing liquid with a viscosity of 2100 centipoise units (Cps). As the slurry concentration increased, the viscosity was raised accordingly, and the nature of the slurry also changed. At 15% slurry concentration (3800 Cps) the slurry was stirrable at 20% (8600 Cps) spoonable, and at 25% slurry concentration (above 10000 Cps) the slurry was thick and doughlike in appearance. Maximum reduction in viscosity was noticed at the inclusion of 4g% ARF in all slurry concentrations (10%, 15%, 20% and 25%). Addition of 4g% level ARF to a 25% slurry tremendously reduced the viscosity to a thin gruel of 3100 Cps adaptable for child feeding purposes. To study the effect of storage on ARF, samples were tested chemically and organoleptically on 0, 15 and 30 days. The parameters analysed were moisture content, alcoholic acidity, amylase activity and organoleptic testing. Per cent increase in moisture content was 1.9% and 3.8% for sun-dried and oven-dried samples respectively. Alcoholic acidity increased from 0.120 (as % H_2SO_4) to 0.0250 and from 0.124 to 0.810 in oven-dried and sun-dried samples respectively. There was only a 4-5% decrease in amylase activity in both sun-dried and oven-dried samples. Organoleptic testing revealed a 5-7% decrease in percentage of maximum scores in both oven-dried and sun-dried samples. The present study indicates the feasibility of utilizing Bunti ARF for preparation of low bulk weaning gruels due to its viscosity reducing property, high amylase activity and keeping quality. In the absence of other cereals and millets in drought conditions, weaning gruels can be prepared from this millet in drought hit areas of Gujarat.

A-14 STUDIES ON REDUCTION IN DIETARY BULK OF YOUNG CHILD FOODS WITH AMYLASE/AMYLASE RICH FOODS

Chinnamma John (1989)

The present study aimed at reducing the dietary bulk of traditional gruels with malted cereal flours known as Amylase Rich Foods (ARFs) and feeding the low and high bulk gruels (with and without ARF) to infants and toddlers (6-24 months) to determine their intake of these gruels and the effect of the gruels on growth. ARFs were prepared from pearl millet (Pennisetum typhoideum) and wheat,.

(Triticum aestivum). Pearl millet was soaked in water for 2 hours, germinated for 72 hours and roasted over open fire in an iron pan for 10 minutes at 70-80 degree C or oven dried for 5 hours at 50 degree C or sun-dried for 5 hours at 40 degree C plus or minus 2 degree C. The dried grains were milled to a fine powder of 80 BSS. The sun-dried ARF showed the highest amylase activity followed by oven-dried ARF. Minimum amylase activity was observed in the roasted ARF. Wheat ARF was prepared by soaking the grains for 12 hours, germinating for 48 hours, oven-drying at 50 degree C for 5 hours and milling the dried grains to a fine flour of 80 BSS. Wheat ARF showed the highest amylase activity (4500 mg of maltose units) as compared to any other ARFs studied in this department. Viscosity measurements with different concentrations (1-7 g% of total solids) of pearl millet and wheat ARF on 10, 15, 20 and 25 per cent solid concentration rice gruels was studied. It was observed that at all concentrations maximum viscosity reduction was brought about by 4% of solid concentration of ARF. Although both the ARFs were effective in reducing the viscosity of the rice gruel, wheat ARF performed better than pearl millet ARF. Therefore, wheat ARF was utilized for further work in this study. When wheat ARF was added to a 30% wheat gruel at levels 4g% or below it did not effect reduction in viscosity. However, on increasing the amount of ARF, optimum viscosity reduction was brought about when ARF was incorporated at 6% of total solids. Wheat ARF at 4g% level was effective in bringing about optimum reduction in viscosity of different solid concentrations of sago and Soya Fortified Bulgar Wheat (SFBW) gruels. When the amylolytic action of wheat ARF was compared with Takadiastase, wheat ARF was more effective than the pure enzyme in reducing the viscosity of sago gruels. Addition of wheat ARF to sago and SFBW gruels prior to and after cooking did not show any difference in the viscosity reduction. Addition of fat and jaggery increased the energy density of both sago and SFBW gruels. Maximum reduction in viscosity was observed, however, only when ARF was added to the gruels. Different methods of milling employed for SFBW namely, traditional stone grinding, milling in a commercial plate mill and milling in a laboratory based mini plate mill did not have any influence on the amylase activity of the ARF and its subsequent reduction of the dietary bulk of the gruels from different flours. When wheat ARF at 4g% of total solids was added to different concentrations of "Khichdi" (rice and legume gruel) and "Chapati" (unleavened bread prepared from wheat flour) flours, it was observed that in the Khichdi flours, there was a 40% reduction in viscosity while in the Chapati flours, there was an 80% reduction in viscosity. This was also obvious visually when ARF was added to the mashed Chapati gruels. Commercially processed foods like biscuits and bread were subjected to ARF treatment and it was observed that highest reduction in viscosity occurred in bread gruels followed by low and medium fat biscuits while high fat salty biscuits showed minimum reduction in viscosity. Acceptability and intake trials of infants and toddlers (6-24 months) with ARF and non-ARF gruels of sago, SFBW and wheat showed that the ARF gruels were better accepted and consistenly consumed at significantly higher levels as compared with the non-ARF gruels. A six months feeding and growth Trial was carried out on infants and toddlers (6-24 months). Thirty four pairs of child subjects, pair matched for age and nutritional status were fed with 20g% solid concentration of wheat gruel with and without ARF (34 subjects each). At the end of the study only 21 pair of child subjects completed the entire study period of six months. The feeding trial with ARF and non-ARF gruels showed that the ARF gruel fed children namely the Experimental group consumed significantly higher amounts of the gruel than the non-ARF gruel fed children namely the Control group. Consumption of the ARF gruel increased as the study period advanced. Data on the morbidity profile showed that although the frequency of illness was the same in both the groups of the child subjects; The Experimental children recovered faster than the Control children. No illness among the child subjects was observed during the winter months. The ARF gruel helped to improve the overall consumption of energy and protein among the child subjects. Almost 20% of RDA for energy and protein was provided with the ARF gruel as compared to only 5% of RDA from non-ARF gruel. Studying the growth pattern of the subjects fed with theExperimental and Control gruel, it was observed that the Experimental children gained significantly in weight, height and mid-upper arm circumference (MUAC) as compared to their Control counterparts. The improvement in weight was more significant in the first and the sixth month of the study. Weight gain was more marked than height and MUAC. This aspect is again observed when wasting and stunting categories were

compared at baseline and at the final stage for the Experimental group; there was a significant improvement in wasting as compared to stunting. Nutritional status of the children improved considerably in the Experimental group as compared to the Control group. There were more children from the Control group in the malnourished category than in the Experimental group at the end of the study. The number of children in the normal grade of nutritional status doubled for the Experimental group of children. While in the Control group, there was a deterioration in the normal nutritional status of children after the 6 months feeding trial. Energy and protein intake per kg body weight of the child subjects was evaluated and the results showed that in the Control and the Experimental group, protein intake was similar at baseline and final evaluation. Energy intake on the other hand showed considerable difference in the Control and the Experimental group. The experimental children consumed 72.1 kcals/kg body weight and the Control group received 63.5 kcals/kg body weight at final evaluation. The controlled feeding trial has conclusively demonstrated the efficacy of the Experimental gruels (ARF gruels) in substantially improving the nutritional status of the young child subjects (6-24 months). It is therefore suggested that this simple and feasible household level technology to reduce the dietary bulk of traditional gruels, be employed on a much wider scale.

A-15

AS ASSESSMENT OF THE TRANSFER OF TECHNOLOGY FOR THE PREPARATION AND USE OF LOW BULK WHEAT FLOUR WEANING GRUELS FROM LABORATORY TO FIELD LEVEL

Urvi M Vaishnav (1989)

The principal goal of this study was an assessment of the transfer of technology for the preparation of low bulk wheat flour weaning gruels, using wheat ARF, from the laboratory to the field level. To achieve the above goal, work was undertaken in the following aspects of the technological transfer: 1) Development and evaluation of wheat ARF prepared in the laboratory under simulated field conditions, 2) First transfer of the knowledge and technique of the preparation and use of ARF to field level trainers, 3) Second transfer of the same technology (as in 2) by the field trainers to the slum mothers, 4) Assessment of the feasibility and success of the second transfer and 5) Follow-up of the second transfer. A total of 40 field level trainers were trained in the technology of preparation and use of ARF for a period of 14 days. This constituted the first transfer. The second transfer consisted of training 188 slum mother respondents in this technology by the field level trainers. The training consisted of 3 trials of the technology during the 14 day period. Booklets and charts were used to reinforce the training. Results of the study revealed that the laboratory technique of ARF preparation and use was practicable at low income group households with some minor adoptive changes, like the use of kaladis (thick flat skillets of baked clay which sold for just a rupee or two each) use of volumetric measures etc. in the details of technology execution. Background sample characteristics such as socio-economic variable did not affect the technological transfer in any manner. However, monthly per capita income exerted some control over the programme attendence of the respondents. A considerable dropout rate was due to a lack of time and family cooperation among the respondents. With an increase in the number of trials there was an increase in the number of mothers doing the steps correctly although there was a concommitant increase in dropouts. A majority of the respondents were willing to buy readymade ARF and the preparation of gruel was preferred to that of ARF. The results of the follow up on 30 mothers showed that respondents who were found to be preparing ARF and gruel did not express any technical problem with the steps. The findings of this study indicate that the technique is simple, adaptable and feasible with respect to low income group households. However, shortening the time required for home based preparation of the ARF would possibly increase long term adoption of the technology. There is also a need for deliberation on the idea of provision of readymade ARF packets for this user population.

A-16 THE DEVELOPMENT OF PROCESSED LEGUME FLOURS FROM BENGAL GRAM (CICER ARIETINUM) AND PEAS (PISUM SATIVUM)

Rajeshwari Mushini (1990)

The germination technology holds promise for enhancing the nutritive value of legumes. Thus the present study was planned for developing quick cooking legume flours from germinated Bengalgram (Cicer arietinum) and Peas (Pisum sativum). The optimal conditions for germination and post germination treatments of the legumes were standardized for the legume flours. The physico chemical properties of the legume flours, their functional properties in typical preparations and their keeping quality were studied. For optimizing the soaking time, the seeds were soaked from zero to 16 h in water thrice the volume of seeds. On the basis of moisture absorption and germination characteristics of seeds, a 12 h soaking followed by 48 h germination and then drying at 65 degree C was standardized. Dried seeds were ground to pass through mesh sizes of 60 and 72 BSS. The product yield was 74% for Bengalgram and 82% for Peas. The physicochemical properties of the flours were assessed in terms of cooking time, amylase activity and reducing sugar content. The cooking time, amylase activity and reducing sugar content. The cooking time of the flours decreased while the amylase activity and reducing sugar content increased on germination. All the food items incorporating these legume flours were largely accepted on the basis of acceptability tests by trained and semi-trained panels. Processing did not adversely affect the functional properties, even though the fat and moisture absorption were somewhat higher in the processed legume flours. The keeping quality of flours was also assessed by storing the flours at room temperature for a period of 30 days in loe density polyethylene (LDPE) bags of various gauges. The legume flours could be stored for 30 days. The moisture absorption was well below the critical level of 14% and peroxide value was less than the critical value of 10%. Organoleptic evaluation proved the flours edible at the end of the storage period. The study revealed the feasibility of preparing quick cooking legume flours using simple germination technology aided by drying, devegetation and grinding procedures. The technology is simple, convenient and adaptable at home and industrial levels.

A-17 THE DEVELOPMENT OF GERMINATED LEGUME FLOURS FROM REDGRAM (CAJANUS CAJAN) AND GREENGRAM (PHASEOLUS AUREUS)

Kousar Parveen (1990)

The present study aimed at developing processed legume flours from redgram (Cajanus cajan) and greengram (Phaseolus aureus) using germination as a technique. This included other related objectives - 1) to standardize the germinating and postgerminating conditions, 2) to study the effect of processing on certain physicochemical properties and 3) to study the effect of processing on acceptability and functional properties. Redgram and greengram flours were prepared by steeping the cleaned seeds for 12 hours in 3 volume water and germinating for 48 and 36 hours respectively, followed by oven drying at 65 degree C. The vegetative parts were removed by hand abrasion, ground and passed through an intermediate mesh of 60 and 72 BSS, to result in a product yield of 73% and 75% in redgram and greengram respectively. Studies on physicochemical properties of germinated seeds revealed that germination brought about a number of changes. In both legume flours the reducing sugar content and amylase activity had increased. The decrease in cooking time was more due to powdering than germination per se. To study the effect of processing on certain cooking qualities, acceptability and functional properties, a number of items were prepared and tested organoleptically using the hedonic scale. It was observed that all the preparations were not apparently affected by the processing technique. The present study indicated the feasibility of utilizing processed legume flour. The technique is simple, inexpensive and adaptable at both household and commercial levels. Such a product can form convenient means of incorporating legume for military ration, diets of special groups like growing and young children or as geriatric foods.

A-18 DEVELOPMENT OF QUICK COOKING LEGUME FLOUR FROM COWPEA (VIGNA CATJANG) AND LENTIL (LENS ESCULENTA)

Minakshi R Sharma (1990)

The present study was undertaken with a view to develop quick cooking legume flours from germinated Lentil (Lens esculenta) and Cowpea (Vigna catjang) using optimum conditions of steeping, germination and post germination treatment. The related specific objectives were to assess certain physico-chemical properties, functional properties and keeping quality of the processed legume flours. Legume flours were prepared by steeping and germinating the grains for 12 and 36 hours respectively followed by drying in oven at 65 degree C till dry to touch and removing the vegetative portion before milling the germinated grains. Then, the flour was passed through seive size of 60 and 72 BSS. The physico-chemical properties of the processed legume flours were studied in terms of cooking time, reducing sugar and Amylase activity. Cooking time was determined on the basis of highest scores given by panel members for doneness. Cooking time was found to reduce by progressive germination. Blanching did not result in any significant changes except in 5 minutes blanching. Germination per se did not result in any major reduction in cooking time. The conversion of legumes into powder contributed mostly towards the reduction in cooking time. Amylase activity was found to increase as the germination period progressed and also with increase in the per cent of malted flour added. Within the period of germination maximum reduction in viscosity was found at 4g% level of malted flour. Amongst all the germination, periods maximum per cent reduction was noticed at 4% level of 48 hours germinated samples of cowpea and lentil respectively. While comparing per cent reduction at different germination periods, on 4% level, addition of malted flours showed higher amylase activity as compared to cowpea. The elaboration of amylase activity was found to be respobsible for the fall in viscosity of gruels. Reducing sugar levels were found to be higher in germinated samples as compared to ungerminated legume flours. Functional properties of various food items prepared by incorporation of the processed legume flours and their acceptability among trained and semi-trained panel was done. Results revealed that all the products were highly accepted and their functional properties were also retained. Fat and Water absorption was found to increase in cowpea and lentil flour food preparations as compared to their respective control food preparations which may be attributed to increased porosity. To observe the effect of storage on legume flours, samples were stored in LDPE bags of 200, 300 and 400 guage thickness, at room temperature. Samples were drawn on 0, 15th and 30th days and were analysed chemically and organoleptically. The parameters used were moisture content, peroxide value and organoleptic evaluation. The samples could be stored at room temperature for 30 days, as per IS specification, in 200 guage polyethylene bags. In 300 and 400 guage size samples might be stored for longer time. In conclusion, quick cooking legume flours on account of their ease of preparation, good keeping quality, good amylase activity, nutritive value and predigestibility can be used effectively. Such convenience foods can be used by the army, in space research, for unexpected guests and as a supplementary food for growing children.

BRIEF SUMMARY OF WORK UNDERWAY

S-1

Suneeta Deshpande

Our previous studies indicated that the ARF from various cereal/millets contained amylase in excess of that required for effective viscosity reduction. Therefore, conditions for the preparation of ARF were restandardised to obtain a product with the adequate amylase for required viscosity reduction. Such a product could be obtained by reducing the steeping and germination period. Experiments are underway to study the effect of reduced steeping and germination period on shelf life of ARF, over a period of 6 months, indicated by moisture content, peroxide value and total viable count. In the South East Asian Region the commonly consumed cereal is rice (Oryza sativa). Paddy, though it can be used for the preparation of ARF, yields a product with poor shelf life due to presence of lipases and lipoxidases. Therefore, attempts were made to develop ARF from soyabean (Glycine max merr) greengram (Phaseolus aureus Roxb) and Bengalgram (Cicer arietinum) which are commonly used in this region. Of the three legumes, soyabean showed presence of some amylase activity on germination for 60-72 hours. The ARF from soyabean was ten times less active than the ARF from the cereal/millet source. Studies on germination of sorghum (Sorghumvulgare) by Panasiuk and Bills (1984) reported the elaboration of HCN from the seeds. The concentration on HCN in shoots was found to exceed the fatal dose for an adult man. Therefore, systematic experiments were planned to study the production of HCN, using a sensitive colorimetric method at various stages of germination in the sprouts, desprouted seeds and seeds with sprouts before and after heat treatment. The high tannin sorghum was found to contain significantly high levels of HCN especially in the sprouts which was reduced to negligible level on heat tratment. ARF from wheat, maize and pearl millet showed only traces of HCN in the raw state and and there was complete destruction on heat treatment. ARF from wheat, maize, pearl millet and sorghum could effectively reduce the viscosity of thick slurries from commercial weaning foods, Corn Soya Milk, Corn Soya Blend, various cereal and pulse mixes and supplementary foods used for feeding the young ones under the ICDS, the national nutrition program. The ARF was required at 3-4% of total solids and was equally effective whether added to the cooked hot porridge or incorporated in the mix and cooked into a porridge. Studies are underway to test the effect of addition of ARF to gruels on digestibility of these gruels using a non-invasive, in vivo method namely lactoscreen breath hydrogen analyser.

S-2

Syed R Nisar

Commercially available bacterial amylase preparations namely BAN (Bacterial Amylase Novo), Tenase and Takalite (Miles Inc. Elkhart) obtained from Bacillus subtilis, and a fungal preparation such as Clearase derived from Aspergillus oryzae were studied for their suitability in reducing the viscocity of different cereal and pulse combinations, used in the preparation of household weaning gruels. The minimum amount of 0.025% of bacterial preparation incorporated into the flour before cooking was adequate to bring down the viscosity to the desirable level of less than 2000 Cp. The fungal enzyme preparation Clearase which is less heat resistant, than the bacterial amylase could not be incorporated before cooking. Incorporating it after cooking when the gruel reached 50°C was found to be more effective. The cost of these enzyme preparations ranges from 3.00 to 6.00 paise for 0.1 gram which is effective enough to reduce the viscosity of 500 ml gruel to the desirable level with 25% total solid concentration. The amount of wheat ARF required will be 5 g which would cost less than 4.00 paise and can be easily prepared at home. Studies on the effect of addition of fillers, fortification of nutrients and storage conditions on the activity of the various amylases are in progress.

APPENDIX

Names of selected grains in some Indian languages

KEY

B - Bengali	Kan - Kannada	Mar - Marathi	Tam - Tamil
G - Gujarati	Kash - Kashmiri	O - Oriya	Tel - Telugu
H - Hindi	Mal - Malayalam	P - Punjabi	

Bajra : *Pennisetum typhoideum*
B-H-O : Bajra G-Mar:Bajri. Kan: Sajje. Kash- Bajru
Mal-Tam: Cambu. Tel: Sazzalu
Other Names : Spiked millet, Pearl millet.

Barley : *Hordeum vulgare*
B : Job. G-H-Mar: Jau. Kan: Jave Godhi. Kash: Wushku
Mal : Yavam. O : Jaba dhana. Tam : Barli arisi.
Tel : Barli biyyam
Other name : Yava.

Bengalgram Dhal : *Cicer arietinum*
B : Cholar dal. H : Chane-ki-dhal. Kan : Kadale bele
Kash : Chola dal. Mal : Kadala Parippu. Mar : Harbara dal.
Tam : Kadalai paruppu. Tel : Sanaga pappu.

Blackgram Dhal : *Phaseolus mungo roxb.*
B : Mashkalair dal. G : Udad. H : Urd dhal. Kan : Uddina bele.
Kash : Maha. : Mal : Uzunnu parippu. Mar : Uddachi dal.
O : Biri. P : Mahdi dhal. Tam : Ulutham paruppu.
Tel : Minapa pappu.

Greengram Dhal : *Phaseolus aureus Roxb.*
B-K : Mung dal. Mar : Mug dal. Kan : Hesara bele.
Mal : Cheru payar parippu. P : Mungi-di-dal.
Tam : Payatham paruppu. Tel : Pesara-pappu.

Jowar : *Sorghum vulgare*
B-G-H : Juar. Kan : Jola. Mal - Tam : Cholam. Mar : Jwari.
O : Janha. Tel : Jonnalu. Other names : Milo, Chari.

Kodo millet : *Paspalum scrobiculatum*
B : Kodoadhan. G-H : Kodra Kan : Haraka.
Mal-Tam : Varagu. Mar : Harik.
O : Kodus Tel : Arikalu. Other Names :
Pakodi, Manakodra.

Lentil : *Lens esculenta*
A : Masurmoha. B : Masoor. G-H-Mar : Masur dal.
Kan : Masur bele. Kash : Musur. Mal : Masur parippu.
O : Masura. P : Masur. Tam : Mysore paruppu.
Tel : Misur pappu.

Maize : *Zea mays*

B : Bhutta. G : Makai. H-Mar-O : Maka. Kan- Musikinu Jola.
Kash : Makaa'y. Mal : Cholam. Tam : Makka Cholam.
Tel : Mokka jonnalu.

Ragi : *Eleusine Coracana*

B-H : Madua. G : Bhav. Kan : Ragi. Mal : Moothari.
Mar : Nachini. O : Mandia. Tam : Kezvaragu. Tel : Ragulu.
Other names : Finger millet, Korakan, Rajika.

Redgram dhal : *Cajanus cajan*

B-H-Kash : Arhar dhal. G : Tuver. Kan : Thugare bele.
Mal : Tuvara parippu. Mar : Turdal. O : Harada.
Tam : Tuvaram paruppu. Tel : Kandi pappu.
Other names : Pigeon pea, Adhaki, Tuvari, Tuvarika.

Rice, raw : *Oryza sativa*

B : Chowl. G : Chokha. H : Chawal. Kan : Akki. Kash : Tomul.
Mal : Ari. Mar : Tondool. O : Chaula Tam : Arisi.
Tel : Biyyam.

Soya bean : *Glycine max Merr*

B : Garikalai. H : Bhatmas. Kash : Muth

Wheat : *Triticum aestivum*

B : Gom. G : Ghau. H : Gehun. Kan : Godhi. Kash : Ku'nu'kh
Mal : Gendum. Mar : Gahu O : Gahama. P : Kamak.
Tam : Godumai. Tel : Godhumalu.

Source : Nutritive Value of Indian Foods by : C. Gopalan, B. V. Rama Sastri and S. C. Balasubramanian; Revised and updated by B. S. Narasinga rao, Y. G. Deosthale and K. C. Pant. National Institution of Nutrition. Indian Council of Medical Research, Hyderabad. India. 1989.

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